UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF NORTH CAROLINA
ASHEVILLE DIVISION

STATE OF NORTH CAROLINA ex rel. Roy Cooper, Attorney General,	)	
Plaintiff,	)	No. 1:06-CV-20
vs.	)	VOLUME 9B (Pages 2159-2202)
TENNESSEE VALLEY AUTHORITY,	)	
Defendant.	)	

TRANSCRIPT OF TRIAL PROCEEDINGS
BEFORE THE HONORABLE LACY H. THORNBURG
UNITED STATES DISTRICT COURT JUDGE
JULY 24, 2008

APPEARANCES:

On Behalf of the Plaintiff:

JAMES C. GULICK, Senior Deputy Attorney General
MARC BERNSTEIN, Special Deputy Attorney General
North Carolina Department of Justice
114 West Edenton Street
Raleigh, North Carolina

MICHAEL D. GOODSTEIN, Esquire
ANNE E. LYNCH, Esquire
Resolution Law Group, P.C.
5335 Wisconsin Avenue NW, Suite 360
Washington, DC

On Behalf of the Defendant:

FRANK H. LANCASTER, Senior Attorney
HARRIET A. COOPER, Assistant General Counsel
THOMAS F. FINE, Assistant General Counsel
MARIA V. GILLEN, Assistant General Counsel
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, Tennessee

Cheryl A. Nuccio, RMR-CRR, Official Court Reporter

I N D E X

I N D E X O F E X H I B I T S

THURSDAY MORNING, JULY 24, 2008

THE COURT: I believe we're ready to proceed, Mr. Fine.

THOMAS W. TESCHE

DIRECT EXAMINATION (Cont'd.)

BY MR. FINE:

Q. Dr. Tesche, before we took our break, we were opening the subject of some omissions that were made in the TVA emissions from the inventory for, I believe, 2013.

A. Yes, sir.

Q. Could you just generally tell us what omissions we're talking about.

A. Well, in particular, our staff that was preparing the emissions for the Tennessee power plants made an error in transcribing the emission rates for two of the -- well, for stacks from two of the facilities, Allen and Shawnee, and we didn't catch that error. As a result, that went through the compilation of the emissions files and we used it in the modeling and it was manifest in the output of our results.

And that error was brought to our attention through the peer review that Chinkin and Wheeler provided in their comments on our expert report.

And that error came about as a result of, essentially, a manual transcription, taking numbers off a data sheet and putting them into the -- electronically into the air quality

model. The individual that made that mistake was the one who had full responsibility for all of the VISTAS emissions modeling, so she was a very skilled modeler, but these things do occur.

MR. FINE: Ms. Shea, if you would do me the kindness of putting Defendant's Exhibit 308 on the viewer.

Q. And Dr. Tesche, if you could turn to Defendant's Exhibit 308 for identification in your book in case the viewer -- the view from the viewer is not clear.

A. I have it.

Q. And could you just briefly tell us what is this -- what does this figure show?

A. This figure shows the modeled and the reported emission rates for annual SO_2 in the TVA modeling. The reported numbers are the ones for the TVA power plants that we used from the Scott report. The modeled numbers are what actually got into the CAMX and the CMAQ model.

And as you can see here, there clearly is a difference in the annual emission rates for SO_2 at the Allen and at the Shawnee facilities.

Q. And this, again, was for the 2013 emissions inventory?

A. Yes, sir.

Q. So this affected just the 2013 modeling output.

A. Just the 2013 model.

Q. And Defendant's Exhibit 308 is for sulfur dioxide?

A. Correct.
Q. And if you'd just turn very quickly to look at Defendant's Exhibit 309.
A. This is the companion exhibit for nitrogen oxide emissions.
Q. And sir, if you know, how many units were omitted at Allen?
A. I think it was two.
Q. Out of how many?
A. Three. I'm not certain on those numbers, to be honest with you. I know more about what the tonnage of the emission totals were, but I don't -- I can't recall right now the number of units.
Q. Do you recall whether it was -- how many units were involved at Shawnee?
A. Gosh, I don't. I think it was one, but I'd have to go back and look at our expert report. Those are facts that have not retained -- been retained.
Q. But they are reflected in your expert report.
A. They are, indeed.
Q. And you spoke of tonnage.

MR. FINE: If I could ask you to turn to Defendant's Exhibit 310. 310, Ms. Shea.

THE WITNESS: Yes, I have it.

MR. FINE: That's all right. We'll do without the

viewer version.
Q. Could you tell us what Defendant's Exhibit 310 is.
A. 310 is a summary of the NOx and SO_2 emission rates reported by Mike Scott and modeled by Alpine Geophysics and TVA. It gives the error that we made in the point source modeling in tons and percent.
Q. And if I'm reading this correctly, it indicates that on -- for the sulfur dioxide, the amount that was omitted from your modeling was consisted -- was about 7 percent of the total for TVA.
A. Yes, sir.
Q. And for oxides of nitrogen, it was about 3 percent of the TVA total.
A. That's correct.
Q. Dr. Tesche, where are the Allen and Shawnee power plants in the Tennessee Valley Authority located?
A. As shown on Exhibit 1 here on the board, the Allen plant is in extreme southwestern Tennessee. Very lower left-hand portion of the state of Tennessee. The Shawnee plant is in western Kentucky right near the Ohio River. Both of these are located on the extreme left-hand or western portion of the TVA service territory.
Q. And how do they -- what sort of distance is between them and North Carolina?
A. Well, I don't -- I don't recall the exact distance in

miles or kilometers, but you can see clearly from this exhibit, the map, that they are the most extreme western -- most -- power plants in the TVA system and are farther away than any other TVA source from North Carolina.

MR. FINE: Your Honor, I'd ask that Defendant's Exhibits 308, 309 and 310 be admitted into the record.

THE COURT: Let those be admitted.

(Defendant's Exhibits Numbers 308, 309 and 310 were received into evidence.)

Q. Dr. Tesche, once the -- Messrs. Chinkin and Wheeler identified this omission, what steps did you and your team take in response to the information?

A. Our first step was to make sure that the reporting of our error was correct, and we quickly ascertained that that was true.

Obviously, the next question that we had to address was, well, what does that mean for the reliability of the modeling that we've done for the future year 2013 case? And an easy way to try and address that would have simply been to look at the magnitude of the emission tons of the SO_2 and NOx and declare that, well, they're very small, 3 percent, 7 percent, and, gosh, they're on the far western side of the service area. So in the process of hand waving, we could declare that it doesn't make any difference.

Alternatively, we could have taken -- corrected the

inventory for these two sources, rerun the full set of CAMX and CMAQ models, reanalyzed everything that we did and addressed that error directly.

The timing was such that we chose a different path that we felt gave us technically very sound -- a technically very sound basis for estimating what the effect was going to be, and that --

Q. If I can interrupt you very briefly, Dr. Tesche. You said the timing was such. What do you mean by that?

A. The timing -- the project timing, the amount of time that we had available to address this error in the context of the overall project, the timing of getting our technical analyses in and updated and provided to TVA.

Q. And to the court?

A. Yes.

Q. And I apologize for the interruption, but you were describing the steps that you took to assess the impact of this omission.

A. Correct. We were fortunate and we realized that we probably didn't have to take that extreme step of rerunning all the modeling, which was certainly not a problem for any other consideration and schedule. We had -- as I said, we had run CAMX and CMAQ, both models, in 2002. We had run CAMX with the Ozone Source Apportionment Tool turned on. We had run CAMX with the PSAT tool turned on. In those two tools, as the

result of their operation, had provided us with source receptor information about the ozone increments associated with TVA power plants in the base year 2002. They also gave us estimates of the fine particulate species associated with TVA power plants in 19 -- or in 2002.

So we felt that with the knowledge of the error in the emission rates coupled with the modeled source receptor relationships from CAMX with PSAT and OSAT for the year 2002, we could make a credible estimate of what the likely impact would be if we were to rerun the models in 2013 with those two corrections made. And that's the approach that we did and that's -- the results are summarized in our expert reports.

Q. Dr. Tesche, I'd like you to turn to a document that's been marked for identification as Defendant's Exhibit 311.

A. Yes, I have it.

Q. What does this figure reflect, Dr. Tesche?

A. This figure has two panels. The left panel is a computer display that shows the incremental effect on annual average $PM_{2.5}$ of the -- the result of the SO_2 emissions error from Shawnee and Allen. In other words, this is the net difference -- excuse me, I'm sorry. I need to back up just a moment here.

This plot on the left is an output of the CAMX PSAT model simulation for the year 2002 which provides a direct estimate of the $PM_{2.5}$ in the region contributed by the Allen and

Shawnee power plants -- contributed by the emissions error that we made.

So it's a quantification -- it's a quantification on the annual average of the aerial extent of the $PM_{2.5}$ that would be associated with these dropped emissions.

Q. How did you use this information to assess the impact on 2013 impacts?

A. The general approach was to take the concentrations that PSAT has given us here for $PM_{2.5}$ and to scale to the future year, and then examine what the scale concentrations would be in North Carolina in 2019.

Q. In 2000 and --

A. I'm sorry, excuse me, 2009. So I need to go a little more slowly here.

We took the PSAT results for 2002 and scaled them to the concentrations that would occur in our estimation in the year 2013 in North Carolina as the result of the PSAT calculations of the impact in 2002. That scaling is done simply as the ratio of the emissions in 2013 relative to 2002.

And we -- as noted in our supplemental report, we recognize that there are limits to how far one can go in directly scaling fine particulate concentrations in the atmosphere from one year to the next based just on emission changes.

Sulfate is probably the most reliable species for that

kind of scaling. Arguably, it's the most quasi-linear of the PM species. And so what we essentially did was to take the sulfate estimates for 2002 from PSAT, scale them to the year 2013. As a factor of conservatism, we doubled that concentration to come up with a proxy estimate for the likely PM_2 increment that would have been added to our modeling in 2013 had we not made the error in dropping emissions from Shawnee and Allen.

Q. And what did you conclude from this exercise, Dr. Tesche?

A. This exercise that we did, notwithstanding the conservatism in the approach, showed that the magnitude of the incremental fine particulate associated with the emission error at Shawnee and Allen was very, very small. Well below a significance level that might be defined on the basis of, say, measurement capability of PM monitors or significance that EPA would have -- or did declare in its CAIR rule making.

Q. You mentioned the ability of monitors to measure $PM_{2.5}$. What is the low end of that ability, if you know, sir?

A. The present generation of regulatory $PM_{2.5}$ monitors that is in use today, operational use, can take us down to about .5 micrograms per cubic meter.

Now, certainly some research grade instruments can detect with some reliability concentrations even below a half a microgram. Perhaps, and I'm not an experimentalist, but perhaps as low as .2 micrograms under ideal laboratory

conditions.

But the numbers that we use for the threshold monitoring for PM_{10} in our work is .5 micrograms per cubic meter.

Q. You mentioned PM_{10}. What about $PM_{2.5}$?

A. I'm sorry. I meant that to be for $PM_{2.5}$.

Q. You mentioned an EPA significance threshold.

A. I did.

Q. Is that from the former Clean Air Interstate Rule?

A. Yes. In the technical support documents that attends the CAIR work that EPA did, they had to make a decision as to whether to declare individual states in the eastern U.S. in or out of further consideration in developing the CAIR emissions caps. And they used a threshold of .2 micrograms per cubic meter as the nominal significance threshold for $PM_{2.5}$.

So on the one hand, you have the CAIR for the EPA significance threshold of .2, using the CAIR rule making. You have the monitoring threshold of about .5. Those two numbers provide sort of a suggestion as to the lower end of the $PM_{2.5}$ concentrations that are significant in the atmosphere or that can be measured or determined as significant.

Q. And using the methodology that you've described, Dr. Tesche, what was your assessment of the impact of the omission -- the emissions omission on North Carolina for $PM_{2.5}$?

A. We concluded that the error that STI found in our

emissions modeling was inconsequential from the standpoint of having an effect on our overall modeling results.

The scaling that we did, the conservative estimation of what the impact would have been had the lowest emissions been incorporated in the modeling at the receptor locations in North Carolina were concentrations that were below this range of significance or uncertainty I've talked about and are far below the concentration level by several orders of magnitude from the regulatory standard.

Q. What was the maximum increment that you found with your methodology?

A. I believe it was .1 microgram per cubic meter.

Q. .1?

A. Yes.

Can I refresh my memory by going back to our expert report?

Q. By all means, Dr. Tesche.

A. I wish to correct my previous statement. I was off by an order of magnitude. That maximum impact that we calculated with the methodology I described was .01 micrograms per cubic meter. And that -- that result derives from the plot that I see in front of me, the left panel, Figure 10. It's in the gray region. You see the gray region in the left panel, Figure 10 goes from .01 to .02. And the .01 impact --

Q. Excuse me, Dr. Tesche, what was the -- what was the gray

region representing according to the scale?
A. This is .0 -- well, the gray region is .000 to .02 micrograms per cubic meter.
Q. All right, sir.
A. And the modeled -- or the estimated impact of the error from Shawnee and Allen was .01. So according to this plotting scheme, it would appear covered with gray in the North Carolina region.
Q. All right, sir.
Now, there's a right panel on Defendant's Exhibit 311. Could you tell us what that's showing.
A. The right panel is the total $PM_{2.5}$ from all sources in the region in the year 2013 under the TVA planned emission scenario.
Q. And what's the maximum amount of $PM_{2.5}$ shown under that scenario for 2013 in North Carolina?
A. Well, just looking at the color scale here, it's a blue to a green scale, and that would correspond to a -- let's say a 6 to 9 or 10 or 12 microgram per cubic meter range.
Q. And how does .01 micrograms per cubic meter compare to that range?
A. Well, it's obviously very much smaller and, indeed, much smaller than the .2 EPA significance threshold used in the CAIR modeling.
MR. FINE: Your Honor, I'd ask that Defendant's

Exhibit 311 be admitted.

THE COURT: Let that be admitted.

(Defendant's Exhibit Number 311 was received into evidence.)

Q. Dr. Tesche, you've already established through your testimony that there was also -- the error or the omission from Allen and Shawnee also involved an underreporting or undermodeling of oxides of nitrogen.

A. Yes, sir.

Q. And oxides of nitrogen are one of the main precursors to the formation of ozone.

A. Not only ozone, but they also play a role in the formation of nitrate aerosol which is a component of $PM_{2.5}$.

Q. All right, sir. What steps, if any, did you take to determine the ozone impact from the omission of the units at Shawnee and Allen?

A. We had the benefit of having run previously the CAMX OSAT, Ozone Source Apportionment Technology tool, and so we had OSAT results available to us with which to possibly support an extrapolation of the effect of this mistake.

We recognized that one is not really able to scale ozone concentrations to a future year based on the ratio of emission rates because the ozone chemistry is highly non-linear and such a scaling simply would be unfounded technically.

But what we did have is the CAMX source apportionment

OSAT results -- the Ozone Source Apportionment Results, which told us what the T -- or what the Allen and the Shawnee power plants were contributing to North Carolina in 2002.

And so armed with that information and the knowledge of the magnitude of the emission error at those two facilities, we were able to estimate what the impact might have been in the year 2013 if we didn't scale the ozone. We simply took the 2002 ozone impacts from the OSAT and said, well, maybe they would apply in 2013.

We do know that the NOx and SO_2 emissions in the region are expected to go down significantly. So taking the 2002 ozone estimate from the OSAT model and say it's going to occur in 2013 would be a conservative assumption. It would err on the side of overestimating what the real impact would be in 2013. And that's what we did.

MR. FINE: Ms. Shea, if you would please display Defendant's Exhibit 312.

Q. Dr. Tesche, you can see that on your screen or in your book, Defendant's Exhibit 312.

A. Yes, I do.

Q. And what is this table purporting to show us?

A. This table provides a summary of the OSAT contributions of the Shawnee and the Allen power plants to ozone in North Carolina expressed in parts per billion associated with this emission error and the combined effect of these two power

plants as a result of this emission error. These are 2002 concentrations. And we have expressed the contribution to maximum ozone here both -- well, for 1-hour ozone and for 8-hour ozone.

Q. Dr. Tesche, help me with this. I notice that the combined impacts are not additive of the individual impacts.

A. Well, there's a straightforward answer to that sort of puzzling observation.

When we estimate these maximum impacts, we're looking at the maximum contribution over the whole summer, the whole summer period. And Allen, the Allen plant, given where it's located geographically, is going to impact western North Carolina differently than the Shawnee plant. And so the combined impact of the ozone from these two power plants is not necessarily going to fall directly on the day when the peak impact from these facilities individually was going to occur. Because they're located almost the width of the northern extent of the state of Tennessee apart, it's like -- it's logical to believe that the days for which the maximum impact of emissions from these two power plants are going to be different.

And when we, in our analysis, look for the combined impact of these two projects, that maximum day is not necessarily going to be the same day as the day for which the maximum Allen impact occurred or the maximum Shawnee impact

occurred. What we see here is it's pretty close, two-tenths of a part per billion difference from a raw sum of these two numbers.

Q. Would you assess for us the magnitude of this impact, this additional impact from the omitted units at Shawnee and Allen on ozone.

A. Let me take the combined impact of 1.2 parts per billion and state that this is -- again, this is an OSAT estimation so it doesn't enjoy the same level of precision that the regular CAMX model gives in its simulated ozone. It's a good projection, but it's not perfect.

Having said that, this is 1.2 part per billion in the year 2002. And if we look at the projected emission tallies for the power plants in the year 2013, their emission rates are going to go down significantly under the plans that are in place. And so this 1.2 part per billion impact is likely to be less. And perhaps far less in 2013 as the result of ongoing emission controls.

In another context, we can say that the national ambient standard is 75 parts per billion presently. So this is 1.2 parts per billion out of 75. In our modeling that we will get into and I have gotten into in our expert report, we've shown that on the days for which the Tennessee Valley Authority power plants exert their highest ozone impact in North Carolina, is days when the ambient concentrations in North

Carolina due to all the other sources, locally and regionally, is well below the standard.

So this increment, 1.2, even if it didn't get reduced in 2013 because of successive controls at these two facilities, would still pale in comparison to the national standard and would not contribute to an otherwise moderate or low background ozone air quality and produce a problem.

MR. FINE: Your Honor, I'd ask that Defendant's Exhibit 312 be introduced into the record.

THE COURT: Let it be admitted.

(Defendant's Exhibit Number 312 was received into evidence.)

Q. Dr. Tesche, in your professional judgment, could you give us an overall assessment of the impact of this -- on the omission of the two units at Allen and the one unit at Shawnee for the 2013 modeling.

A. The impact of the error that was made in processing the Shawnee and Allen future year emissions we've demonstrated is inconsequential. It is a very, very small projected increment that is, in my opinion, unimportant with respect to the larger concern, the larger potential impacts from the full fleet.

MR. FINE: Ms. Shea, would you please display the document marked for identification as Defendant's Exhibit 276.

Could you expand that just a bit, Ms. Shea.

Thank you.

Come back a little bit so we can see the scale. I think that's probably as good as we're going to get.

Thank you, Ms. Shea.

Q. Dr. Tesche, do you have that in front of you?

A. Yes, sir.

Q. And could you describe for us what this figure is trying to tell us.

Let me actually back up and ask a couple of other questions first, and I apologize.

Is this figure part of your modeling output that you and your team did for the modeling in this case?

A. Our team produced this figure, yes.

Q. And this is a -- displaying the -- a region including the states of Tennessee and North Carolina and their neighbors?

A. That's correct.

Q. And returning to my original question, what is this figure trying to tell us?

A. This is one of those figures I alluded to earlier that seeks to distill a lot of air quality modeling output into a simple and hopefully direct presentation of results. This is an ozone plot and what it is showing is the difference between ozone predictions in the 2013 base case run compared with 2013 with the Tennessee plan.

So essentially, the color that you see on this page is a measure of the additional ozone reductions that would be

achieved if TVA were to install the additional controls North Carolina seeks.

The scale goes from zero to 16 parts per billion. Federal standard for ozone 8-hour is 75. This is a plot of the results over the 12 kilometer VISTAS domain which we've used in the TVA modeling. You'll notice here that we have used equal concentration increments in our plotting so that we weight each concentration band equally with its own color.

This plot basically shows, if you have a good pair of reading glasses, that the concentrations associated with additional controls on TVA, there are some ozone improvements in western North Carolina. And if you just eyeball the scale, you'll see that the improvements are in the blue scale and there's one little box that's light blue. So that would be concentrations in the range of zero to, say, 4 or 5 parts per billion.

Now, there is higher ozone elsewhere, but that's within other states. Not the issue here.

Now, there's two other points I would make about this plot. When we looked at the underlying numbers here, not just the color rendition of the output, we found that the highest grid cell in North Carolina that was -- or the grid cell with the highest ozone improvement from the TVA additional controls was 5.2 parts per billion ozone on the 8-hour average. That was the maximum additional benefit in 8-hour ozone in the year

2013 expected to result from additional controls on TVA.

We also looked at the total model output on that day and days surrounding it and determined that the total ozone concentrations to which this 5.2 might be added was well below the ambient standard, well below the 75 parts per billion.

Q. Dr. Tesche, is this type of display sometimes referred to as a Tom Map?

A. Yes, some modelers refer to it as a Tom Map, mostly if they have gray hair. This was named after me when we first developed this plotting style back in the mid '70s. But it's a very common display of how one would portray the incremental effect of an ozone or a $PM_{2.5}$ impact.

Now, there's an important point to note here. You'll notice that the concentration range from zero to 2 is painted gray. And clearly the model is going to produce some numbers that are between zero and 2 parts per billion. And we have elected to portray that band width as gray or white depending on your printout. And we do that for a particular reason.

First of all, we -- when we plot these results, we try and select a range of concentrations and intervals that portray the main essence of this plot, the main story going on. And if we were to select a thousand color increments, for example, the plot would be uninterpretable. And if we only selected two color increments, the plot would similarly not yield a lot of information. So we strike a balance between

the number of intervals we present trying to present the main message.

The other thing is that we select a lower bound, this zero to 2, as sort of the nominal cutoff to reflect what we believe is a level of significance for this particular analysis. It's not that we hide the results by any means because our full output is archived and made available for others to examine and review. It's just that for concentrations between zero and 2 parts per billion for this kind of differential analysis, we conclude that those impacts are of less importance to the main story going on which is the concentrations that range between, say, 2 and 10.

Now, this choice, this method has drawn some criticism, but this is the method that we use and that's how we've presented these particular results.

Q. Thank you, Dr. Tesche.

MR. FINE: Your Honor, I'd ask that Defendant's Exhibit 276 be admitted into evidence.

MR. GOODSTEIN: Objection, Your Honor. It's misleading per the testimony of Mr. Chinkin and Mr. Wheeler. This presentation shows -- purports to show that there are no impacts in the white area, and Dr. Tesche just testified that that's not true.

MR. FINE: Your Honor --

MR. GOODSTEIN: So we would object to it as

misleading.

MR. FINE: Your Honor, that sounds like grounds for -- grist for cross examination. And Dr. Tesche has also already testified as to why he selected this particular display scale.

THE COURT: Objection is overruled.

MR. GOODSTEIN: Thank you, Your Honor.

(Defendant's Exhibit Number 276 was received into evidence.)

Q. Dr. Tesche, if you would please turn to a document marked for identification as Defendant's Exhibit 277.

MR. FINE: Ms. Shea, if you would please display that.

Thank you, Ms. Shea.

Q. Dr. Tesche, do you have that in front of you?

A. I do.

Q. And again, sir, this is some of the modeling output that you and your team produced in this -- for this case?

A. This is post-processing of the modeling output. It's our attempt to portray certain features of the output that address a particular issue. Ozone in this particular case.

Q. And what is this portraying, if you would please tell us.

A. This plot attempts to show the relative contribution of the Tennessee Valley Authority power plants as a group, the North Carolina power plants as a group, and all other manmade

emission sources in the southeastern U.S. and central U.S. as a group, and their relative contribution to 8-hour ozone at three monitoring locations strung out across west -- or North Carolina from west to east: Great Smoky Mountains National Park, Charlotte and Raleigh.

The lower panel is really a blowup of the upper panel, and we needed to do that, as you can probably tell, because the scale of the power plant impacts is so small relative to the dark bars, the other sources in the region, that we felt more resolution in the lower panel would enable us to understand better the relative impacts of the two power plant fleets.

These results are based -- these are so-called zero-out results with CMAQ. In these particular runs, we set to zero all of the emissions from the 11 fossil plants at TVA, ran the CMAQ model and compared those concentrations in the year 2002 and 2013 against the base case.

So we have a direct -- we have a direct estimate of what the impact of the TVA fleet would be in the year 2013 on 8-hour ozone. Similarly for the Clean Smokestacks controls on the North Carolina units.

The lower panel shows that at the Great Smoky Mountains National Park, the role of North Carolina power plants in contributing to 8-hour ozone, the red bars, is substantially larger, at least in eyeballing this lower panel, than the

contribution from the TVA power plants.

And a similar story holds for Charlotte and Raleigh farther to the east in North Carolina.

Q. Dr. Tesche, if you'll pardon me, but just so that we're clear as to what we're looking at here. In each of the, what I'll call the subcategories, the Great Smoky Mountains, Charlotte and Raleigh, we see three bars, correct?

A. That's right.

Q. And the first bar is the 2002 base case scenario?

A. Correct.

Q. And the next -- the next bar represents the circumstances under the TVA emissions control plan?

A. That's right.

Q. And the third bar would represent how things would be if the additional controls from -- what North Carolina wants under the Clean Smokestacks Act were imposed on TVA.

A. That's correct. So this output gives you an estimate of how the relative role of TVA in North Carolina power plants will perhaps change at these three monitors going from the year 2002 to 2013, and in that future year, what the difference between the two plans would produce.

Q. The two plans?

A. The two plans being the Clean Smokestacks controls applied to TVA and to North Carolina EGUs versus the Clean Smokestacks controls being applied to the TVA power plants in

addition to their planned controls.
Q. You mentioned the term zero-out, Dr. Tesche.
A. Yes.
Q. What is that -- what is the implications of the zero-out scenario?
A. Well, there are several. The main implication here is that the zero-out type of modeling experiment is a hypothetical and largely implausible scenario. It's an upper bound. It provides a worst case because there is no proposal to completely zero-out emissions from all the North Carolina power plants such as was done in the zero-out run. There's no proposal to zero-out, to concrete over all of the TVA power plants in the future.

But in the modeling we and EPA and others will perform these kinds of bounding experiments to see what the aggregate effect of that emission category is. So the actual effect, the actual ozone increments that might be associated with the North Carolina or TVA power plants in the future year is expected to be a whole lot less because they're not going to be set to zero but they will have some level of emissions in the year 2013.

MR. FINE: I'd ask that Defendant's Exhibit 277 be admitted into evidence.

THE COURT: Let it be admitted.

(Defendant's Exhibit Number 277 was received into

evidence.)

MR. FINE: Ms. Shea, if we could display Defendant's Exhibit 278.

Q. Dr. Tesche, do you have that in front of you?

A. Yes, I do.

Q. Again, is this a part of the graphical display of the modeling output produced by you and your team?

A. Yes, sir.

Q. Is this another Tom Map?

A. Well, let's call it a DE plot, deficit/enhancement, okay. And what that refers to, it's a term that describes the fact that when we subtract one power plant run from another, there are going to be some areas where ozone, or PM in this case, will go up and some other areas where it will go down. There will be a deficit and an enhancement with respect to zero.

So I would refer to this as a deficit/enhancement plot and it's analogous to the one we just saw for ozone. But it is based upon the subtraction of the two 2013 scenario runs.

The scale that we've used here begins at zero, and we have used the first color cutoff at .1. That's one-half of the significance level that EPA uses. The measurement threshold level is .5 for reference. The concentration increments -- these are -- the way to interpret the blue color is that the amount of blue is the amount of additional $PM_{2.5}$ that would be reduced as a result of additional Clean

Smokestacks controls on TVA. And what we see is a lot of blue and some light blue on this plot that would suggest that the effects of the Clean Smokestacks controls, additional controls on TVA would largely be confined to central Tennessee and northern Alabama.

Now, we did look at the concentrations across the domain to find out what were the impacts in North Carolina. Even though we have colored this plot zero to .1 micrograms as gray scale, it didn't mean that we didn't ask, well, what's under the gray. We did that. And in North Carolina, the maximum impact from the additional controls on TVA was a negative .065 micrograms per cubic meter.

Now, I want to mention one thing here. I reported that number as minus 0.65, three points -- three after the decimal place. I am not asserting that that is the level of precision associated with this modeling. I'm using that third number more as an illustrative example to help us understand what the difference in some of these concentrations might be. Again, I'm not asserting that that's the precision of the model at .06, or .07 if we wanted to round up, but that simply was a number. It's a small number. And that occurred in North Carolina in a third of a grid cell. One location, one grid cell, two-thirds of which is owned by Tennessee.

Q. And again, that maximum impact was .065?

A. Yes, sir.

MR. FINE: I'd ask that Defendant's Exhibit 278 be admitted into evidence.

MR. GOODSTEIN: Same objection, Your Honor. Misleading.

THE COURT: Overruled.

(Defendant's Exhibit Number 278 was received into evidence.)

MR. FINE: Ms. Shea, would you please display Defendant's Exhibit 279.

Q. Do you have that in front of you, Dr. Tesche?

A. Yes, sir.

Q. And once again, sir, is this part of the graphical representation of your modeling output?

A. Yes.

Q. And could you please describe what this figure is trying to demonstrate.

A. This is a similar figure of CMAQ zero-out results portraying the years 2002 and 2013 but for fine particulate, $PM_{2.5}$.

Q. This is somewhat similar at least in concept to --

A. In concept, correct.

Q. In concept to Defendant's Exhibit 277 for ozone; is that correct?

A. That's correct. However, there is a difference here in the focus areas. Whereas, before we were looking at a couple

of the big cities, Raleigh and Charlotte, here we're looking at nonattainment areas, nonattainment counties in North Carolina.

Q. Nonattainment for what?

A. Nonattainment for $PM_{2.5}$.

Q. All right, sir.

A. And what these represent, again, is the maximum possible $PM_{2.5}$ impacts from either the TVA fleet or the North Carolina fleet in the context of all other sources, the large black bars. And what we see in the lower panel, at all three nonattainment counties, the yellow is a fair degree smaller than the red for 2013, and what that simply means is that the contribution from the TVA power plants to the modeled $PM_{2.5}$ levels at these three nonattainment areas is noticeably less than that contributed by the North Carolina power plants. Again, these represent a maximum impact, not likely to occur in reality because no one proposes seriously to turn off all those generators.

MR. FINE: Your Honor, I'd ask that Defendant's Exhibit 279 be admitted.

THE COURT: Let it be admitted.

(Defendant's Exhibit Number 279 was received into evidence.)

MR. FINE: Ms. Shea, if you would please display Defendant's Exhibit 280.

Q. Do you have that in front of you, Dr. Tesche?
A. Yes, sir.
Q. Now, this apparently is shifting the focus to something other than what we've been discussing. We've been talking about ozone and particulate matter. Again, this is part of the graphical display from your modeling output?
A. Yes, sir.
Q. And what are we talking about here? This is obviously neither ozone nor particulate matter.
A. No, it's related in a sense. What we're looking at here is the total sulfate deposition under both wet and dry conditions. That is, under raining or foggy conditions and the dry deposition in the gas phase.

We are examining several different physical locations across North Carolina. These are CAMX -- excuse me, CMAQ zero-out simulations. And what we're plotting here in both scales is the deposition of total sulfate in the common units of kilograms per hectare.

Now, not everyone may be familiar with a hectare. That's a unit of area measurement. One hectare is about the size of, oh, say a couple of football fields put side by side, or another way, you could probably put two and a half acres inside a hectare. So that probably gives you a rough idea of how big a hectare is.

And these deposition amounts are annual totals of total

sulfate at these different locations.

The take-away message in this particular plot is that the contribution of the Tennessee Valley Authority power plants seems to diminish as one goes from west to east. In particular, Great Smoky Mountains east, second set of histograms, compared with Swan Quarter, which is out on the coast.

The other take-away message is that in these particular instances, especially closer to the mountains, the border, the deposition amounts for sulfate associated with the TVA power plants in some cases exceed those for the North Carolina fleet.

But regardless of which fleet you're looking at, their impact on sulfate deposition is quite small relative to the deposition associated with other sources in the southeastern United States.

Q. Dr. Tesche, I think you may have already touched on some of these, but when we say GSMW and GSME, that's Great Smoky Mountains west and east?

A. Yes.

Q. Of course, Shining Rock, Linville Gorge and Swan Quarter are the other entries in this figure.

A. Linville Gorge which is a Class I -- I think it's a Class I area and Swan Quarter. These are areas where the EPA has national deposition monitoring sites located and so deposition

data are available both for sulfate and nitrate, and we capitalized on those datasets to construct this portrayal.

MR. FINE: I'd ask that Defendant's Exhibit 280 be admitted into evidence.

THE COURT: Let it be admitted.

(Defendant's Exhibit Number 280 was received into evidence.)

Q. And changing focus again to a certain degree, Dr. Tesche, changing focus in regard to visibility seems, perhaps, appropriate.

MR. FINE: If you would, please, Ms. Shea, display Defendant's Exhibit 281.

Q. And if I understand Defendant's Exhibit 281, it's talking about something called a Haze Index?

A. Yes, sir.

Q. And Dr. Tesche, you understand that TVA will have another expert talking specifically about visibility matters later in our presentation, but just so that we can understand the information you're presenting in this figure, could you please explain what it is that you are displaying, what is the frame of reference you're using.

A. Okay. The Haze Index is a metric that the Regional Haze Rule recommends be used as a measure of visibility conditions. It is mathematically a relationship involving the concentrations of individual pollutant species, sulfate,

nitrate, organic aerosols, and so on. So it's a measure of the individual aerosol components in the atmosphere. It's formalized in a Haze Index, and what we're plotting here is the Haze Index from zero to 35, and then expanded view zero to 3 for the several monitoring stations that I mentioned previously with respect to acid -- or sulfate deposition. This plot shows what the maximum effect of the TVA in North Carolina power plant fleets would be on the Haze Index in 2013.

Q. For any particular set of days, Dr. Tesche?

A. Yes. This is for the 20 percent worst days or the 20 percent haziest days during the period of record. And that's important because in the Regional Haze Rule we're asked to analyze both the 20 percent worst days, to fix them up, and the 20 percent best days to make sure they don't get degraded.

Here our focus -- or this presentation is what are the roles of the two power plant fleets on visibility expressed as the Haze Index at different sites across North Carolina on the 20 percent worst days in the 2002 meteorological record.

Q. And just so that it's clear in the record, your scale refers to an abbreviation called DV. Could you tell us what that stands for.

A. DV stands for deciview and that's the unit of measure for the Haze Index.

Q. And we'll hold for our Dr. Tombach about what exactly

goes into that, but --

A. Please.

Q. And just in general terms, what are we looking at here, sir?

A. We're looking at the variation in the visibility expressed through the Haze Index at the five different sites across North Carolina. And we see that the yellow bars which represent TVA's estimated contribution seems to be larger the closer you are to the Tennessee border and diminishes as you go eastward. Conversely, the significance of the North Carolina power plants seems to increase as you go from west to east.

The upper panel shows that the power plants themselves are a minor contributor to the visibility degradation for the year 2002, at least for these worst case days.

And I would add that this plot gives some rebuttal to those that -- or excuse me, this plot would challenge those that declare that the hazy days in the Smokys are caused by power plants. For 2002, at least, this information shows that it's other sources of air pollution that are the predominant contributor at these five sites.

MR. FINE: Your Honor, I'd ask that Defendant's Exhibit 281 be admitted into the record.

THE COURT: Let that be admitted.

(Defendant's Exhibit Number 281 was received into

evidence.)

MR. FINE: Ms. Shea, if you would please display Defendant's Exhibit 282.

You might want to have 283 handy to hand shortly.

Q. Dr. Tesche, do you have Defendant's Exhibit 282 for identification in front of you?

A. Yes, sir.

Q. And what is this showing?

A. This is a histogram that shows the annual SO_2 emission rates from the 11 TVA fossil plants for four different scenarios or base years. Each power plant has four bars associated with it. The left most is the emission rates in 2002. Next is the emission rates in 2005. The last two bars represent -- or the third bar is Mr. Scott's estimate of what the emission rates will be once the hardware that's being installed or is installed is operational and the other fuel switching and controls are implemented in the TVA plan by the year 2013. And the fourth is the emission estimates that were offered up by Dr. Staudt for the TVA power plants under the Clean Smokestacks set of controls.

MR. FINE: Ms. Shea, if you would please display Defendant's Exhibit 283.

Q. Dr. Tesche, is this a histogram showing the -- in the same format information on emissions of oxides of nitrogen?

A. Yes, sir.

Q. In the same fashion that you just described?
A. That's right.
Q. Is that correct?
A. Yes.
Q. Looking at Defendant's Exhibits 282 and 283, Dr. Tesche, if you recall, was there a reporting error when these -- when this information was initially displayed in your initial expert disclosure report?
A. Yes, there was an error made in transposing the numbers from the data sheets to the Excel plotting program. And that error was brought to our attention and we corrected the plot. That error did not affect the modeling. That was something as part of a post-processing operation and doesn't -- unlike the Shawnee and Allen situation we've already discussed, that didn't find its way into the air quality modeling at all.
MR. FINE: I'd ask that Defendant's Exhibits 282 and 283 be admitted.
THE COURT: Let those be admitted.
(Defendant's Exhibits Numbers 282 and 283 were received into evidence.)
MR. FINE: Ms. Shea, if you would please display Defendant's Exhibit 284.
Q. Dr. Tesche, we're moving into a series of exhibits concerning what I'm going to call more specific displays, graphical displays of the emissions -- of the out -- excuse

me, the modeling output that you and your team produced in this case. And I'd ask you to initially look at the figure that's been marked for identification as Defendant's Exhibit 284. I believe you have that in front of you.

A. Yes, sir.

Q. And if you could again, please, sir, describe for us what is this figure?

A. This is a plot for $PM_{2.5}$ that focuses on the base year 2002. It's a zero-out simulation which we have set to zero all of the TVA power plants, their emissions of NOx and SO_2, run the model, and then subtracted the output from the 2002 base case run.

So this plot shows essentially the maximum improvement in $PM_{2.5}$ annual air quality in the southeastern United States as the result of removing all TVA emission -- fossil emission sources.

Q. Again, this is a zero-out situation?

A. That's correct.

Q. This is assuming that the TVA power plants are entirely shut down, the fossil plants.

A. Yes, sir.

Q. When you look at the scale on the left of Defendant's Exhibit 284, what was the scale you selected to use for this figure?

A. Well, we selected for this scale concentrations ranging,

obviously, from zero up to 1.0. For reference, the EPA significance level for $PM_{2.5}$ was .2, somewhere midrange in those dark blue colors. And .5 is the monitoring, sort of the monitoring threshold.

And what we see here is that surrounding the states of Tennessee and North Carolina, there's a large region of blue which refers to impacts of .1 to, say, .3 micrograms per cubic meter as a result of full zero-out of TVA emissions in 2002.

On the border between North Carolina and Tennessee, the color scale suggests that there could be -- or that there are concentration impacts in the range of, say, 4 -- excuse me .4 to .6 micrograms per cubic meter. I'm just getting that by eyeball here.

And again, this is a maximum hypothetical amount of $PM_{2.5}$ improvement because there are no plans to fully eliminate TVA emission sources from the fossils.

Q. So this is, if you will, the upper bound --

A. Yeah.

Q. -- of a reduction in $PM_{2.5}$.

A. Correct. It's a very conservative upper bound.

Q. Now, you selected a scale that goes from 0.0 to 0.1 showing gray.

A. Yes.

Q. Why did you select 0.1 as the first increment that would show as a color on this display?

A. Well, again, our intent in this display was to tell the main story. And the main story was what was the -- what were the impacts from this zero-out simulation? And what we wanted to show is the general extent where the impacts were great. And so we picked a scale that would allow us to show red where red occurs and to show blue where -- in the outermost portions of the region where the concentrations are low. And this number, .1, is, I think, arguably a lower bound on the significance of $PM_{2.5}$ model estimates for an annual average. And so that's the choice that we made.

Q. Dr. Tesche, based on your modeling output, what can you tell us about the impact of zeroing out, shutting down the TVA fossil system on $PM_{2.5}$ in North Carolina?

A. Well, if that implausible scenario were to occur, this modeling suggests in the year 2002 that the air quality benefit in North Carolina would range between, say, somewhere below .1 microgram on the coast to, perhaps, as high as .5 micrograms or more.

Now, that's an extreme emission control scenario, obviously. And yet, the concentration improvement for fine particulate from, say, .1 up to .5 is a number that is small relative to the annual standard of 15 micrograms, but when expressed in the context of what one can measure with equipment and what EPA determines is significant, it's also a smallish quantity.

And furthermore, as I said earlier, this is an extreme hypothetical scenario. Real controls on either Tennessee or North Carolina would not produce this level of impacts. They'd be less.

Q. Because the plants would actually still be running.

A. Well, yes, sir.

MR. FINE: I'd ask that Defendant's 284 be admitted into the record.

THE COURT: All right. Let it be admitted.

(Defendant's Exhibit Number 284 was received into evidence.)

MR. FINE: Ms. Shea, would you please display what's marked for identification Defendant's Exhibit 285.

Q. Dr. Tesche, I believe you have that in front of you.

A. Yes, sir.

Q. And what are we looking at here?

A. This is a companion analysis as -- to what we just saw for a zero-out of the Tennessee power plants, but here we've looked at, for context, a zero-out of the North Carolina power plants. It's the same base year meteorology. The emissions are all the same with the exception that we've set to zero the emissions from the North Carolina power plants. Same scale. Same plotting scale.

Q. What sort of magnitude of impact would there be for zeroing out, shutting down the North Carolina power plants for

$PM_{2.5}$?

A. In the state of Tennessee, the impacts, as we see from the dark blue and light blue and a little bit of green, would be concentration increments in the range of .2 to, say, .4 or .5. Sort of what we saw for the North Carolina impacts of shutting down the TVA facilities.

In the core of North Carolina, however, we see far greater, or a larger spatial extent of high $PM_{2.5}$ benefits as the result of zeroing out North Carolina power plants. And that's manifest by the red and the bark blue tiles. We didn't -- we didn't see that level of intensity of $PM_{2.5}$ benefit in Tennessee as the result of zeroing out the Tennessee power plants.

Going back to the previous exhibit, the maximum benefit in the TVA domain was about a microgram, 1.0 microgram. Here it's almost doubled, it's 1.7 micrograms, in the state of North Carolina to be achieved as a result of cutting off all of the North Carolina power plants.

The other thing is that the concentration levels that are identified in surrounding states are higher than the previous situation. The North Carolina zero-out run that we have in front of us are showing that there are the potential for $PM_{2.5}$ impacts as great as .7 or .8 micrograms in the surrounding state of Virginia.

Q. What about South Carolina?

A. South Carolina actually looks like it's getting -- or the model is producing a higher $PM_{2.5}$ impact there compared with Virginia. Concentrations there are easily in the .7 to .9 or .95 range.

MR. FINE: I'd ask that Defendant's 285 be admitted.

THE COURT: All right.

(Defendant's Exhibit Number 285 was received into evidence.)

THE COURT: And gentlemen, we're going to be lenient about lunch today. We'll quit now and come back at 2 o'clock. I have to meet with some other folks.

(Lunch recess at 12:30 p.m.)

*****

UNITED STATES DISTRICT COURT

WESTERN DISTRICT OF NORTH CAROLINA

CERTIFICATE OF REPORTER

I certify that the foregoing transcript is a true and correct transcript from the record of proceedings in the above-entitled matter.

Dated this 24th day of July, 2008.

s/Cheryl A. Nuccio
Cheryl A. Nuccio, RMR-CRR
Official Court Reporter